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results across laboratories and demographic groups. Nevertheless, objective measurement of PA, sedentary behavior, and sleep represents a significant advance in our ability to accurately quantify behavior. This ability should ultimately result in improved understanding of mechanistic associations between energy balance and health and more efficient, accurate and precise evaluation of public health interventions.

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The International Children's Accelerometry Database (ICAD): Methods and Major Findings

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This symposium described the design and initial findings from the 'International Children's Accelerometry Database (ICAD) project. Professor Riddoch described ICAD and the collection of more than 40,000 Actigraph files and accompanying phenotypic data from more than 20 studies. Dr. Sherar described the pooling and data-reduction process. Data has currently been pooled from 19 studies with 42,310 viable raw data files from children age 1–18 years. Dr. Cooper presented descriptive data outlining differences in physical activity between countries. Gender differences in physical activity were present in all countries, being stronger for moderate and vigorous physical activity (MVPA) than overall physical activity. Dr. Ekelund presented initial analyses describing associations between physical activity, sedentary behavior and selected metabolic CVD risk factors. Using meta-analysis of more than 15,000 children, time spent in MVPA, but not time spent sedentary, was associated with lower waist circumference, and lower blood pressure, independent of confounding factors. Dr. Troiano highlighted the public health importance of ICAD. Accelerometers provide information unavailable through self- or proxy-report. ICAD will allow examination of additional behavioral aspects that are not available with self-reports, such as breaks in sedentary time, as well as novel metrics of physical activity currently under development.

Keywords: pooling, physical activity

This symposium described the design and initial findings from the 'International Children's Accelerometry Database (ICAD) project. Professor Riddoch chaired the symposium and introduced the ICAD project. He briefly described ICAD together with the process of approaching principal investigators from more than 20 studies who might potentially contribute data, and the subsequent acquisition of more than 40,000 raw Actigraph accelerometer files and accompanying phenotypic variables. Physical activity is now accepted as an important health-related behavior in children.[1] Accelerometers constitute an important advance in our ability to measure children's physical activity with greater precision and are now being used in larger children's studies. An 'instrument of choice'—the Actigraph accelerometer—has emerged and this instrument has been used in the majority of studies. Further, a high level of communication between research teams has resulted in relatively consistent protocols being applied in terms of instrument set-up and

administration. This consistency of instrument choice and the protocols applied increases the feasibility of a data 'pooling' project.

The advantages of a pooled database are

- It is cost-effective, as the data have already been collected
- A pooled database increases statistical power and hence the ability to detect small differences and associations. In effect, analyses constitute 'meta-analyses using individual data'
- As data may be pooled from diverse cultures and locations, greater socio-cultural diversity can be achieved
- A large and diverse pooled database constitutes a valuable resource for the scientific community.

Dr. Sherar described the pooling and data-reduction process. With the advent of new objective measurement tools children's physical activity can be more accurately quantified. However, there is still a potential for error in the methods used to generate outcome variables from raw accelerometer data. ICAD has adopted robust methods to analyze the pooled raw accelerometer files. Data has currently been pooled from 19 studies from the United States, South America, Europe, and Australia. In all, 42,310 viable raw data files from children age 1–18 years were pooled (Figure 1).

A variety of Actigraph models (GT1M, 7164, 71256), testing epochs (5, 10, 15, 30, and 60 secs), and number of days that the monitor were deployed (3–7 days) were identified. KineSoft (ver. 3.3.32) was used to analyze the raw data files. All epochs were integrated to 60 seconds for analysis. No imputation of missing data took place. Sixty minutes or more of consecutive zeros were identified as non-wear, allowing for 2 minutes of interruptions. Methods were developed to identify spurious data—1.3% of the viable Actigraph .dat files were deemed spurious and were removed from further analysis.

The comprehensive ICAD database now includes a range of standardized physical activity variables summarizing the quantity and quality of physical activity and sedentary behaviors. The impact of 1) sampling epoch, 2) Actigraph model, and 3) over-night wear on the pooled data was also discussed.

Dr. Cooper presented descriptive data outlining some key differences in physical activity between countries. Cross-national comparisons of physical activity allow public health policy makers to understand how national levels of activity and inactivity compare with other countries and to help establish priorities for improving physical activity levels. However, few robust objective data are available to compare levels of activity or inactivity. ICAD provides a unique dataset within which such differences can be explored. The preliminary data presented showed that the well established gender difference in physical activity was present in all countries, being stronger for moderate and vigorous physical activity (MVPA) than overall physical activity, and that overall physical activity differed between countries (Figure 2). MVPA showed substantial differences between countries, with levels highest in Iceland, Estonia and Australia, whilst sedentary time (defined as time <100 counts /min) was broadly similar between countries with the exception of high levels in Brazil. Within countries with more than 1 sample, levels of activity between studies were similar for children of equivalent age.

Dr. Ekelund presented initial analyses describing associations between physical activity, sedentary behavior and metabolic CVD risk factors. Abnormal metabolic profiles are observed in young children, possibly due to the increase in prevalence of overweight and obesity starting at early age. However, higher levels of physical activity may protect against an adverse metabolic risk profile. Data from the European Youth Heart Study (EYHS) suggest that children who accumulated more than 90 minutes of moderate and vigorous intensity activity per day were less likely to have an adverse metabolic risk

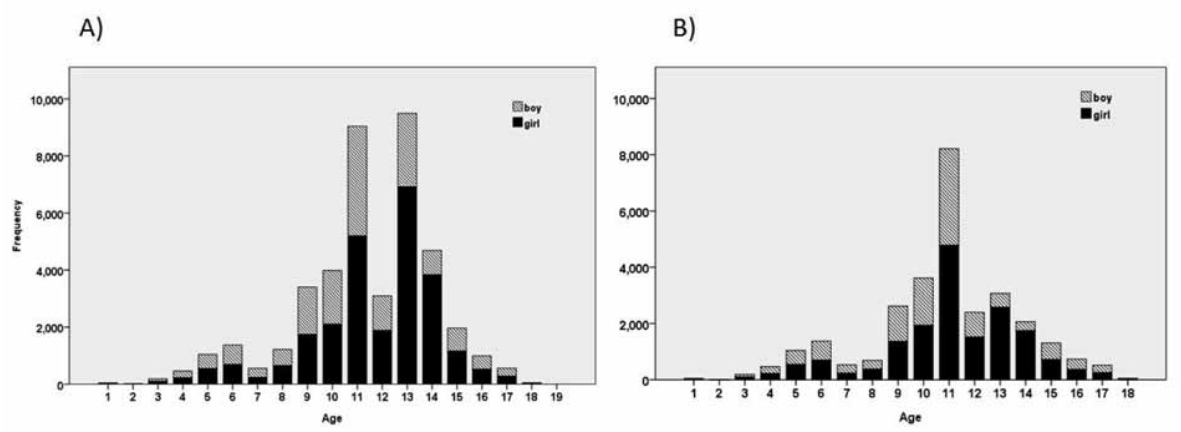

Figure 1 — Sample size of the ICAD by age and sex a) including repeated measures and b) including baseline measures only.

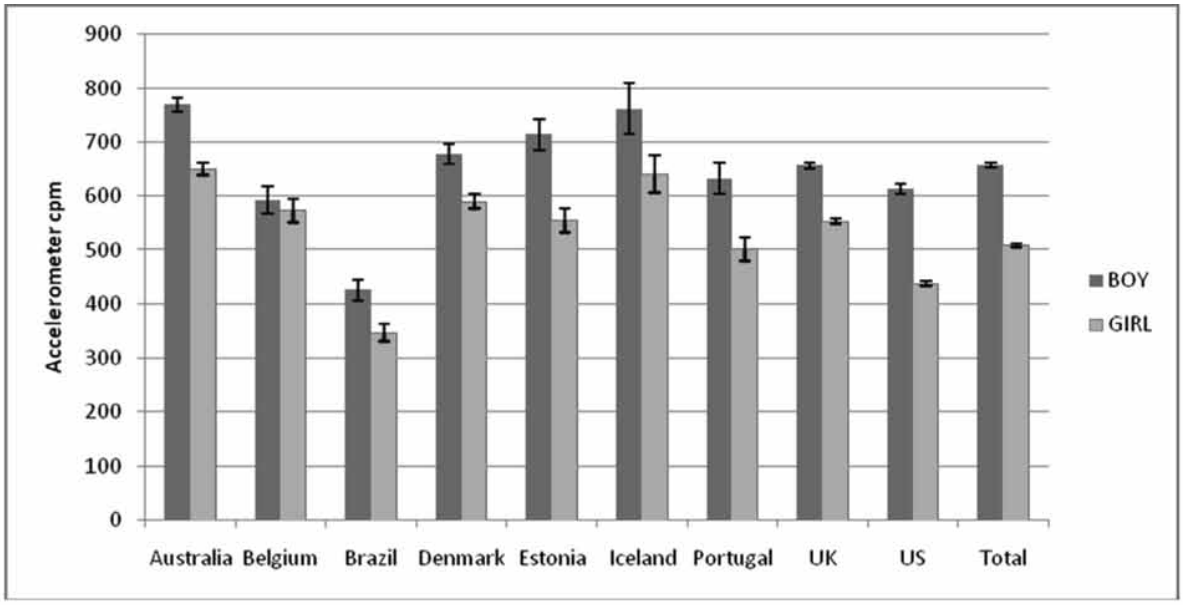

Figure 2 — Physical activity data in counts/min by country and gender.

profile.[2] Further, in a combined analysis from the EYHS it was suggested that physical activity was associated with most individual metabolic risk factors independent of time spent viewing TV.[3] However, the independent effect of objectively measured sedentary time and MVPA with metabolic risk factors is less known. Preliminary data, using meta-analysis, including more than 15,000 children from the ICAD data base suggested that time spent in MVPA, but not time spent sedentary, was associated with lower waist circumference, and lower blood pressure, independent of confounding factors. For example, although significant heterogeneity between studies was observed, the results indicated that an increase in about 15 minutes of MVPA was associated with a 0.4 mm Hg lower systolic blood pressure. These preliminary results suggest that increasing MVPA may be more important than reducing sedentary time in relation to metabolic outcomes in healthy children.

Dr. Troiano highlighted the public health importance of ICAD. The value of physical activity for children and adolescents is gaining increased attention. Globally, prevalence of pediatric obesity is rising and Type 2 diabetes is appearing among youth. Pediatric aerobic fitness has declined dramatically since the 1970s and the decline appears to be accelerating.[4] Resources to explore physical activity and its relation to health and demographic factors are needed. Accelerometers provide information unavailable through self- or proxy-report. Youth lack the cognitive ability to provide accurate quantification of their physical activity. Accelerometers avoid these cognitive issues and provide date and time information that facilitates exploration of factors like weekday vs. weekend patterns, in-school and after-school activity, and allow linkage to season or meteorological data. The pooled accelerometer data in ICAD provide standardized physical activity metrics to compare prevalence and associated factors across multiple countries and settings. In the future, ICAD will allow examination of additional behavioral aspects that are not available with self-reports, such as breaks in sedentary time, as well as novel metrics of physical activity currently under development.

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